

## **PATENT APPLICATION**

### **ELECTROLYTIC CELL FOR SURFACE AND POINT OF USE DISINFECTION**

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#### **CROSS-REFERENCE TO RELATED APPLICATIONS**

This application claims priority to and the benefit of filing of U.S. Provisional Patent  
10 Application Serial No. 60/448,994, entitled "Electrolytic Cell for Surface and Point of Use  
Disinfection", filed February 21, 2003. This application is also a continuation-in-part  
application of U.S. Patent Application Serial No. 09/907,092, filed on July 16, 2001  
entitled "Portable Water Disinfection System". This application is also related to U.S.  
Patent Application, Attorney Docket No. 30750-1001, entitled "Gas Drive Electrolytic  
15 Cell", filed February 23, 2004. The specifications and claims of each application listed  
are incorporated herein by reference.

#### **FIELD OF THE INVENTION**

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This invention relates to the production of oxidants in an electrolytic cell that are  
introduced into an aqueous solution used as a disinfectant or sanitizing liquid.

#### **BACKGROUND OF THE INVENTION**

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This invention involves electrolytic technology known generally in the art.  
Electrolytic technology utilizing dimensionally stable anodes (DSA) has been used for  
years for the production of chlorine and other mixed-oxidant solutions. Dimensionally  
30 stable anodes are described in U.S. Patent No. 3,234,110 to Beer, entitled "Electrode

and Method of Making Same". An example of an electrolytic cell with membranes is described in U.S. Patent RE 32,077 to deNora, et al., entitled "Electrode Cell with Membrane and Method for Making Same". An electrolytic cell with dimensionally stable anodes without membranes is described in U.S. Patent No. 4,761,208 to Gram, et al.,  
5 entitled "Electrolytic Method and Cell for Sterilizing Water."

The invention also involves the use of electrolytic cells to produce an oxidant. Commercial electrolytic cells have been used routinely for oxidant production that utilizes a flow-through configuration that may or may not be under pressure that is adequate to create  
10 flow through the electrolytic device. Examples of cells of this configuration are described in U.S. Patent No. 6,309,523 to Prasnikar, et al., entitled "Electrode and Electrolytic Cell Containing Same," and U.S. Patent No. 5,385,711 to Baker, et al., entitled "Electrolytic Cell for Generating Sterilization Solutions Having Increased Ozone Content," and many other membrane-type cells. In other configurations, the oxidant is produced in an open-type cell  
15 or drawn into the cell with a syringe or pump-type device, such as described in U.S. Patent No. 6,524,475 to Herrington, et al., entitled "Portable Water Disinfection System."

The word "sanitize" means: to make sanitary, as by cleaning or sterilizing. The word "disinfect" means: to free from disinfection, esp. by destroying harmful microorganisms;  
20 *broadly*; cleanse. The word "disinfectant" means: a chemical that destroys vegetative forms of harmful microorganisms esp. on inanimate objects but that may be less effective in destroying bacterial spores. Webster's Ninth New Collegiate Dictionary (1984) For purposes of this application, the words sanitize, disinfect, disinfectant and variants thereof are used in the broad sense as meaning, cleanse.

A specific type of electrolytic cell that produces an oxidant is disclosed in U.S. Patent Application Serial No. 09/907,092 to Herrington, et al., one of the inventors of the invention described and claimed in this application, entitled "Portable Water Disinfection System," the specification of which is incorporated herein by reference. The specification describes

5 disinfection devices that utilize, in one instance, an electrolytic cell chamber in which hydrogen gas is generated during electrolysis to provide a driving force to expel oxidant from the cell chamber through a pressure-sensitive check valve. In this configuration, unconverted electrolyte is also expelled from the body of the cell as hydrogen gas is generated. In an alternate configuration described in the same application, hydrogen gas  
10 pressure is contained in a cell chamber during electrolysis, but the pressure within the cell chamber is limited by the action of a spring loaded piston that continues to increase the volume of the cell chamber as gas volume increases. Ultimately, a valve mechanism opens, and the spring-loaded piston fills the complete volume of the cell chamber forcing the oxidant out of the cell chamber. Another electrolytic cell configuration is disclosed in  
15 U.S. Patent Application, Attorney Docket No. 30750-1001, entitled "Gas Drive Electrolytic Cell" filed concurrently herewith. The specification describes a sealed cell during the electrolysis that produces the oxidant which results in a build up of gas pressure, primarily H<sub>2</sub> released at the cathode, which overcomes a check valve that opens to expel both the gas and the oxidant.

20 U.S. Patent No. 3,996,126 to Rasmussen describes an electrolyzed saline solution generated in a closed container and used to treat teeth and oral cavities. A propellant gas, electrical pump, or manual pump is utilized to force the electrolyzed saline solution out of the container through a tube.

U.S. Patent 4,019,986 to Burris, et al, describes a portable ozone generator and container for purifying water. U.S. Application US 2002/0175085 A1 to Harkins, et al, relates to a stationary electrolyzed oxidizing water system for spraying a sanitizing solution on eggs. U.S. Patent 6,502,766 B1 to Streutker, et al, relates to a motorized sprayer for attachment to a bottle. U.S. Patent 6,363,951 B1 to Wood describes an ozone generation system for use in a water containing device such as a sink for disinfection of materials placed in the sink.

These prior art systems are generally large industrial or commercial apparatus producing large quantities of solution and are therefore not suitable for residential use by consumers. The devices lack portability due to their size as required for a disinfectant or sanitizing solution that may be applied at various locations without the need for pipes or hoses. The prior art does not disclose an apparatus that is low cost, convenient and simple to operate, store, and activate for the production of an oxidant that may be introduced to an aqueous solution which may then be used as a disinfectant for a wide variety of objects.

BRIEF SUMMARY OF THE INVENTION

The present invention comprises an apparatus and method for producing an oxidant to treat a liquid that may be dispensed from a spray bottle or other container as a

5 disinfectant. The apparatus of the invention is low-cost, small and simple, suitable for consumer residential use, although industrial, medical and military applications are also within the scope of the invention. The apparatus may comprise a hand-held portable spray bottle or other container that is initially filled with a liquid, preferably water. The apparatus further comprises at least one electrolytic cell. The cell includes at least two electrodes, one  
10 electrode comprises at least one cathode and another electrode comprises at least one anode. Many types and configurations of electrodes may be suitable for the electrolytic cell of the present invention. The apparatus comprises a control circuit for selectively delivering an electrical charge between the cathode and the anode from any energy source.

15 The energy source, electrically connected with the control circuit, delivers a controlled electrical charge having a value determined by the cell characteristics, such as the electrolyte type and quantity, size, and other factors. The energy or power source may be a standard or rechargeable battery, direct AC connection or solar power. During generation of oxidants, an electrolyte, preferably comprising a sodium chloride brine solution  
20 or a sodium chlorite solution, is located within the cell housing between the anode and cathode. Other oxidants may be produced, based upon the desired application including other halogen oxides, such as chlorine dioxide. The controlled electrical charge passes through the electrolytic solution from cathode to anode, thereby generating at least one oxidant in the electrolyte. A valve or other means may be used to control fluid connection  
25 between the cell and the liquid within the container.

In one embodiment, a fluid such as water is placed in the bottle, and oxidants produced within the electrolytic cell are transferred to the water to produce a solution with a free available chlorine concentration of sufficient strength to effectively sanitize the material or surface of an object. In alternative embodiments, the bottle can be an open bottle, closed bottle, or bottle with a spray nozzle or other pumping means to transfer the solution within the bottle to the material or surface to be treated.

In one embodiment of the present invention, the spray bottle is placed on a base unit. The base unit comprises an electrolytic cell, electrolyte storage compartment, power supply, and control circuit. Oxidants produced in the base unit are transferred to the interior of the spray bottle through a valve mechanism. The spray bottle is then removed from the base and used to disinfect surfaces, foods, or other materials requiring sanitization.

In an alternative embodiment of the present invention, the spray bottle includes a handle that houses an electrolytic cell, electrolyte storage compartment, power supply, and control circuit.

In yet another embodiment of the present invention, the spray bottle includes a separate, compact, electrolytic oxidant-producing device or module that removably, mechanically attaches to the spray bottle. In this embodiment, the electrolytic device is used for production of a number of discrete charges of concentrated oxidant and is then replaced when the oxidant production capacity is depleted. The replaceable oxidant producing device comprises an electrolytic cell, electrolyte storage compartment, power supply, and control circuit.

Other objects, advantages and novel features, and further scope of applicability of the present invention will be set forth in part in the detailed description to follow, taken in conjunction with the accompanying drawings, and in part will become apparent to those skilled in the art upon examination of the following, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The accompanying drawings, which are incorporated into and form a part of the specification, illustrate several embodiments of the present invention and, together with the description, serve to explain the principles of the invention. The drawings are only for the purpose of illustrating several embodiments of the invention and are not to be construed as limiting the invention. In the drawings:

Fig. 1 is a view of a bottle mounted on an oxidant-producing base unit.

Fig. 2 is a bottle with an oxidant producing unit housed within the handle of the bottle.

Fig. 3 is a bottle with a separate replaceable oxidant-producing device or module removably attached to the bottle.

## DETAILED DESCRIPTION OF THE INVENTION

Commercial electrolytic cells are in production to produce a mixed-oxidant solution.

5 This process is described in U.S. Patent No. 4,761,208 and subsequent patents and applications, referred to above, all incorporated herein by reference. The disinfectant produced in this process is very effective for inactivation of microorganisms, particularly microorganisms that are resistant to treatment by conventional chlorine, whether in gas, liquid (sodium hypochlorite), or solid (calcium hypochlorite) form.

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A simple version of an oxidant producing device useful in the present invention is described and shown in Figs. 1, 2, and 3 of U.S. Patent Application Serial No. 09/907,092 for "Portable Water Disinfection System", incorporated herein by reference. Another oxidant producing device useful in the present invention is described and shown in U.S. Patent  
15 Application, Attorney Docket No. 30750-1001, entitled "Gas Drive Electrolytic Cell", filed concurrently herewith. Other variations and configurations of an electrolytic cell can be produced to accommodate various applications.

The object of the current invention is to incorporate an electrolytic cell into a spray  
20 bottle or other container for cleaning solution to enhance the disinfection performance of the cleaning solution. The cleaning solution may have many application including household or industrial surface cleaning (countertops, lavatories, etc), an enhanced cleaning and disinfection solution for washing hands in a sterile environment, for cleaning of medical instruments, and any other application where inactivation of viruses, bacteria, protozoans,



molds, spores, volatile organic compounds, pesticides, herbicides, chemical contamination agents, cyanide, and other undesirable matter can be destroyed by the oxidant solution.

Referring to Fig. 1, one embodiment of the present invention comprises base unit **20**

5 with bottle **22** placed on a horizontal surface for receiving the bottle. In this embodiment, bottle **22** comprises a spray bottle. In alternative embodiments of the present invention, the bottle may be a closed or capped bottle, or an open bottle. In the first embodiment, base unit **22** comprises electrolytic cell **46**, circuit board **34**, and electrolyte storage container **32**. In this embodiment, power supply **36** is attached by an electrical cord to base unit **22** and  
10 plugs directly into a wall electrical outlet. In an alternative embodiment of the present invention, power supply **36** is located within base unit **22** and plugged directly into an electrical outlet.

In the first embodiment of the present invention, in order to commence operation,  
15 fluid **24**, preferably water, is introduced into bottle **22**. Activation switch **38** is pressed by the user thereby activating production of oxidants. Electrolyte within storage container **32** is transferred to electrolytic cell **46**. Electrical power is applied to electrolytic cell **46** through control circuit **34**. Status of oxidant production and fault conditions such as low electrolyte levels or other conditions are indicated by illumination of status lights **40**. Upon completion  
20 of oxidant generation within electrolytic cell **46**, oxidants are transferred to the interior of bottle **22** via a valve and probe **42**. Probe **42** provides fluid communication with the liquid in bottle **22** via self sealing valve **44** which is integral to bottle **22**. Other user controlled apparatus may be employed to transfer the electrolyte to the solution within bottle **22**. After

oxidants are transferred to the interior of bottle **22**, fluid **24'** comprises a free available chlorine concentration of sufficient value to sanitize desired objects.

In the first embodiment of the present invention, bottle **22** is removed from base unit **20** and is transported by the user to other locations for the purpose of disinfecting or sanitizing surfaces, food products, or other materials. Bottle **22** comprises handle **26** which further comprises spray trigger **28** and spray nozzle **30**. In the first embodiment, handle **22** comprises oxidant efficacy indicator light **48**. Oxidant efficacy indicator light **48** provides status to the user of the free available chlorine oxidant strength in fluid **24**. Oxidant efficacy indicator light **48** is activated via electrical contact **50**. Oxidant efficacy indicator light **48** is powered from a capacitor circuit located within handle **26**. In an alternative embodiment, oxidant efficacy indicator light **48** is powered by a battery located within handle **26**. In this alternative embodiment, activation of oxidant efficacy indicator light **48** is triggered by a radio frequency signal generated by an RF circuit located within base unit **20**.

An alternative embodiment of the present invention is shown in Fig. 2. In this alternative embodiment, the apparatus comprises bottle **22** and sprayer head **54**. Sprayer head **54** comprises an electrolytic cell, a power supply, a control circuit, sprayer nozzle **30**, spray handle **28**, and electrolyte container **32**. Sprayer head **54** includes oxidant efficacy indicator light **48**. Sprayer head **54** plugs directly into an electrical wall outlet via electrical connector **52** to provide power to recharge a battery located within sprayer head **54**. The battery within sprayer head **54** provides the power to deliver a charge to the electrolyte within the electrolytic cell to produce oxidants. In an alternative embodiment, electrolysis

within the cell within sprayer head **54** is powered directly from the electrical wall outlet via electrical connectors **52**.

Yet another embodiment of the present invention is shown in Fig. 3. In this  
5 embodiment, electrolytic cell module **60** comprises an electrolytic cell, electrolyte source, power source, and control circuit. Electrolytic cell module **60** is removable from bottle **22**, preferably by threads or other mechanical fluid-tight sealing mechanism to bottle **22**. Electrolytic cell module **60** is removable for replacement as a complete assembly from bottle **22**. In an alternative embodiment, the electrolyte cell and power source are replaceable  
10 components that attach to electrolytic cell module **60**. In this embodiment, electrolytic cell module **60** comprises the electrolytic cell and control circuit. The oxidant produced by module **60** is in fluid connection with the liquid in bottle **22**.

Applications of the present invention are especially applicable to low-cost water  
15 treatment systems for home use by consumers. However, it will be obvious to those versed in the art that this invention can be utilized in a variety of applications including spray bottle applications for surface cleaning, potable water treatment systems, wastewater treatment systems, food cleaning applications, medical instrument sterilization, surgical wards, hospital environments, military medical applications, military chemical and biological  
20 weapons decontamination, wound treatment, and other applications where a disinfectant is utilized.

Although the invention has been described in detail with particular reference to these preferred embodiments, other embodiments can achieve the same results. Variations and  
25 modifications of the present invention will be obvious to those skilled in the art and it is

intended to cover all such modifications and equivalents. The entire disclosures of all references, applications, patents, and publications cited above, and of the corresponding applications, are hereby incorporated by reference.

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